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THE PERCENTAGE OF MOISTURE IN COAL AS DELIVERED TO PURCHASER

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by

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THE PERCENTAGE OF MOISTURE IN COAL AS DELIVERED TO THE PURCHASER.

The cost of coal constitutes approximately one half of the total cost for power. Every substance in the coal which adds to its weight and decreases its heat density is a direct disadvantage in that it must be paid for at the same rate as the coal. The two most important of these undesirable substances are moisture and ash.

It is well known that the available supply of high grade fuels is rapidly decreasing and with the decrease comes a corresponding increase in the price, which tends to raise the cost of power. Consequently the question of how much inert substance is contained in every ton of coal purchased is of prime importance. In order to meet this condition many of our large power producers have found it advisable to test their coal as received. They now buy under contracts which, as a rule, specify a maximum percentage of ash and moisture and a minimum heat content or B.T.U. per pound, certain penalties being inflicted upon failure to meet these conditions.

For a certain definite grade of coal coming from a certain mine or even mines in certain localities the percentage of ash is about constant. Thus a purchaser may know about how much ash he is likely to find in coal if he knows its grade and where it is mined but he has no such check on the

moisture. It would be necessary for him to test each load as received in order to determine this factor.

MOISTURE. The total moisture in coal may be divided into two parts. The first known as "surface moisture" can be removed by exposing the coal in a room at ordinary room temperature for a period of twenty-four hours or more, depending upon the amount of this moisture. This process is known as air drying. It has been found that any given sample of coal will always dry to practically the same point whenever air dried no matter how wet it may have been at first. This moisture is largely due to the underground water which may be percolating thru the coal beds, to the washing of the coal at the mine and to the weather conditions during shipment.

The second part of the moisture is that which is left after air drying and is permanently in the coal at room temperature. It is so intimately related to the coal itself, that to be completely removed the coal must be heated to a temperature above 212°F. for a period of one hour or more depending upon the size of the sample being tested. This moisture must be considered as a legitimate part of the coal because of this intimate relation.

OBJECT. It is the purpose of this thesis to find the variation in the percentage of moisture in coal as delivered to the purchaser.

CONDITIONS UPON WHICH MOISTURE DEPENDS. The first condition upon which moisture depends is the method of handling after mining. Some grades of coal are loaded for shipment as they are mined, others are crushed, sorted and washed to remove dust. That which is washed is loaded while still very wet and if the weather is cold so that the water freezes before it has a chance to drain the purchaser will buy a large quantity of ice along with his coal and pay the same price per ton for it as he does for his coal. Coal which is not washed, as well as that which is, is likely to be rained upon during transit and the same conditions for freezing will hold true. It is not uncommon to find car loads of coal so firmly frozen as to require the use of a pick when unloading. On the other hand coal which is shipped in warm dry weather has every opportunity to dry, and even a portion of the surface moisture which may have been present when mined may be evaporated.

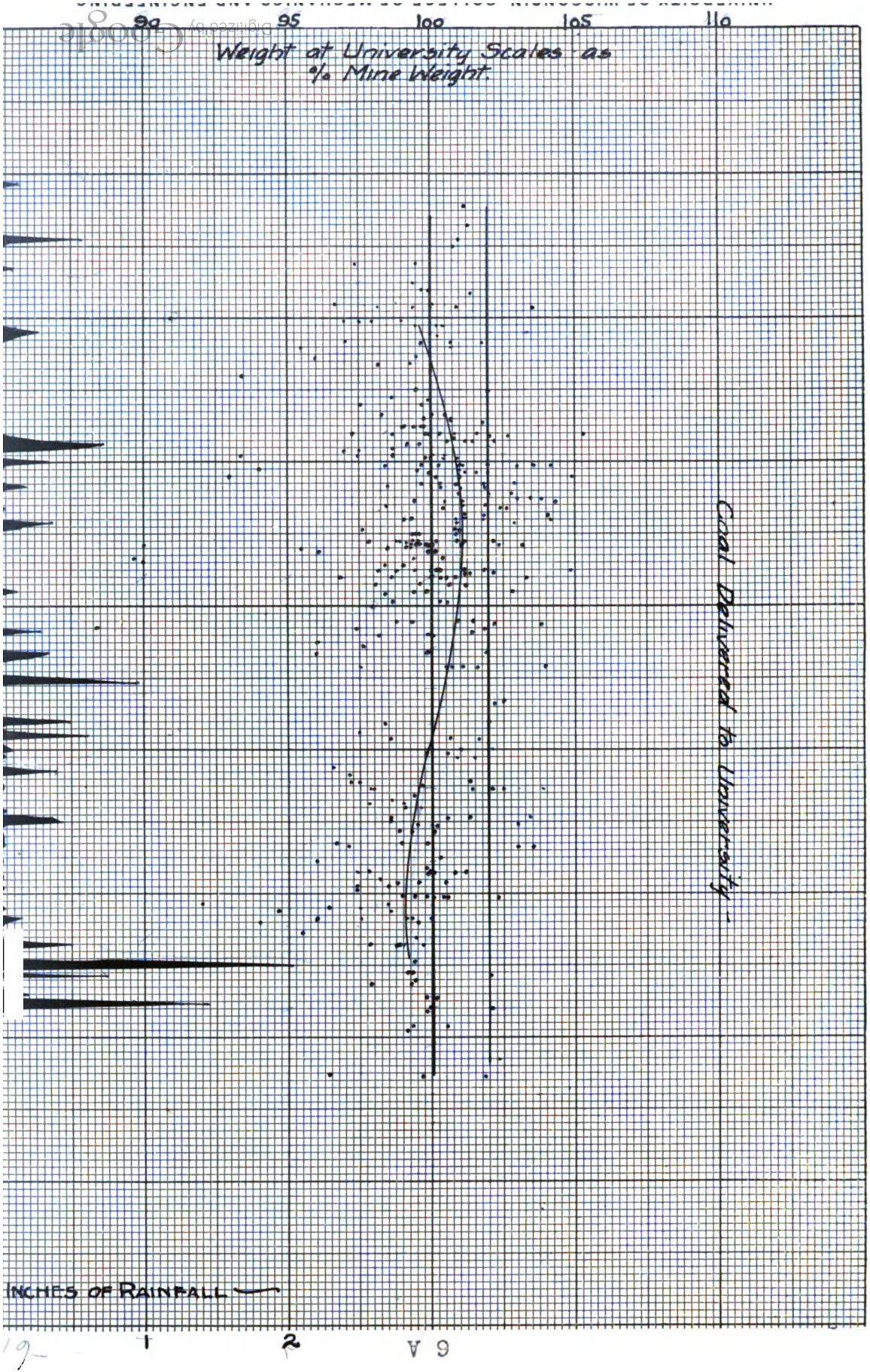
METHOD - COMPARISON OF WEIGHTS. Two methods were used in securing data, first by comparing weights at the mine with weights at the point of delivery, second by direct test. The University of Wisconsin buys the coal used in its heating plant as weighed on its scales at delivery. These weights were compared to the shipping weights and reduced to percentages taking shipping weight as one hundred percent. About

four hundred cars were received between September and June. The railroad deducted two percent from the weight as received at the mine for losses during transportation, which is to cover what drying may occur as well as the coal which may be lost in shipment.

DIRECT TESTS. For direct tests average samples of car loads were taken at different times during the year. These samples were kept in tightly sealed glass jars until tested. The surface moisture test was made by crushing coal to pea size and weighing jar and coal. The coal was then spread in a thin layer on a sheet of paper and exposed to the air for at least twenty four hours. While the coal was drying the jar was left open so that whatever moisture might have collected on the interior walls might be evaporated. After drying the coal and jar were again weighed, the loss of weight was thus obtained and the percentage of surface moisture calculated. Samples of the air dried coal were then powdered to pass a one hundred mesh sieve and completely analysed. The remaining moisture was removed by heating to a temperature of about 230°F. The combustible and ash were determined by heating a small sample in a blast flame until all combustible was burned out. The B.T.U. content was found by means of a Parr Calorimeter.

RAINFALL CONDITIONS. The daily precipitation as observed in Madison was obtained from the Weather Bureau for the period over which the other data extended.

CURVES. All the data as obtained above has been plotted graphically with time as abscissae, for the first delivered weight as percent of shipping weight and for the second percent of surface moisture as ordinates. In all curves the rainfall conditions have been plotted at the bottom of the page. This was done so that variations due to rainfall might be readily seen. The average curve of shipping and delivered weights shows that the rail road has taken about a general average for yearly conditions. From November to February the curve rises slightly above one hundred percent and from February to June it falls slightly below. This at once leads to the conclusion that during the winter months the surface moisture in the coal as delivered is greater than during the fall and spring. We may justly assume that the loss of coal during transit would tend to be constant. All the points may be more or less effected be direct loss of coal which would tend to lower them but to what extent we cannot tell. For instance one car was received with the bottom dump partly open and as a result the delivered weight was about seventy percent of the shipping weight.


90
95
100
105
110
Weight at University Scales as % Mine Weight.
Coal Delivered to University
INCHES OF RAINFALL
1
2

DISCUSSION OF FIRST CURVE. As we have stated before the rail road deducts two percent from mine weight for losses during transit. Thus points falling above the one hundred and two percent line would show destinctly that something had been added during transit. Rain is the only plausible explaination. Thus since a car may be several days on the road we would look for points above the one hundred and two percent line during or shortly after a rain. The first point we find which falls above comes ten days after a slight rain in October and can hardly seem to have any connection with it. It is possible that the car may have been in a rain storm during transit which did not touch Madison and is consequently not shown. The second point falls on the second day of a rain. During November several points fall above and all show an intimate connection to the heavy rain which fell about the twentieth of that month. During December and January we find a great number of points above the one hundred and two percent line, and we also notice that there was rainfall generally distributed thru that time. During the first of February the number of points falls off and at the end they drop below in spite of a series of light rainfalls. During the rains in March a few come above while in April we find but two, and these closely following the two heaviest rains of the season. These points show that if rain falls

on a car it may increase shipping weights as much as five percent and that this increase is most likely to occur during the winter months when it will be retained as ice or snow.

We find thruout a great number of points falling below the one hundred percent line, some of which go as low as ninety percent. These apparently have been effected by other than moisture conditions. For instance the day after the heaviest rainfall in April we find that two cars were delivered at but ninety nine and one fourth percent of shipping weight. The day of the heaviest rain in November which had been preceded by two days of rain two cars were delivered each at about ninety nine and one third percent of shipping weight, the day before four cars were delivered all above one hundred percent and the day following one car was delivered at ninety eight and three quarters percent altho the rain still continued. This points conclusively to the fact that moisture is but one of the factors which causes a variation in weights.

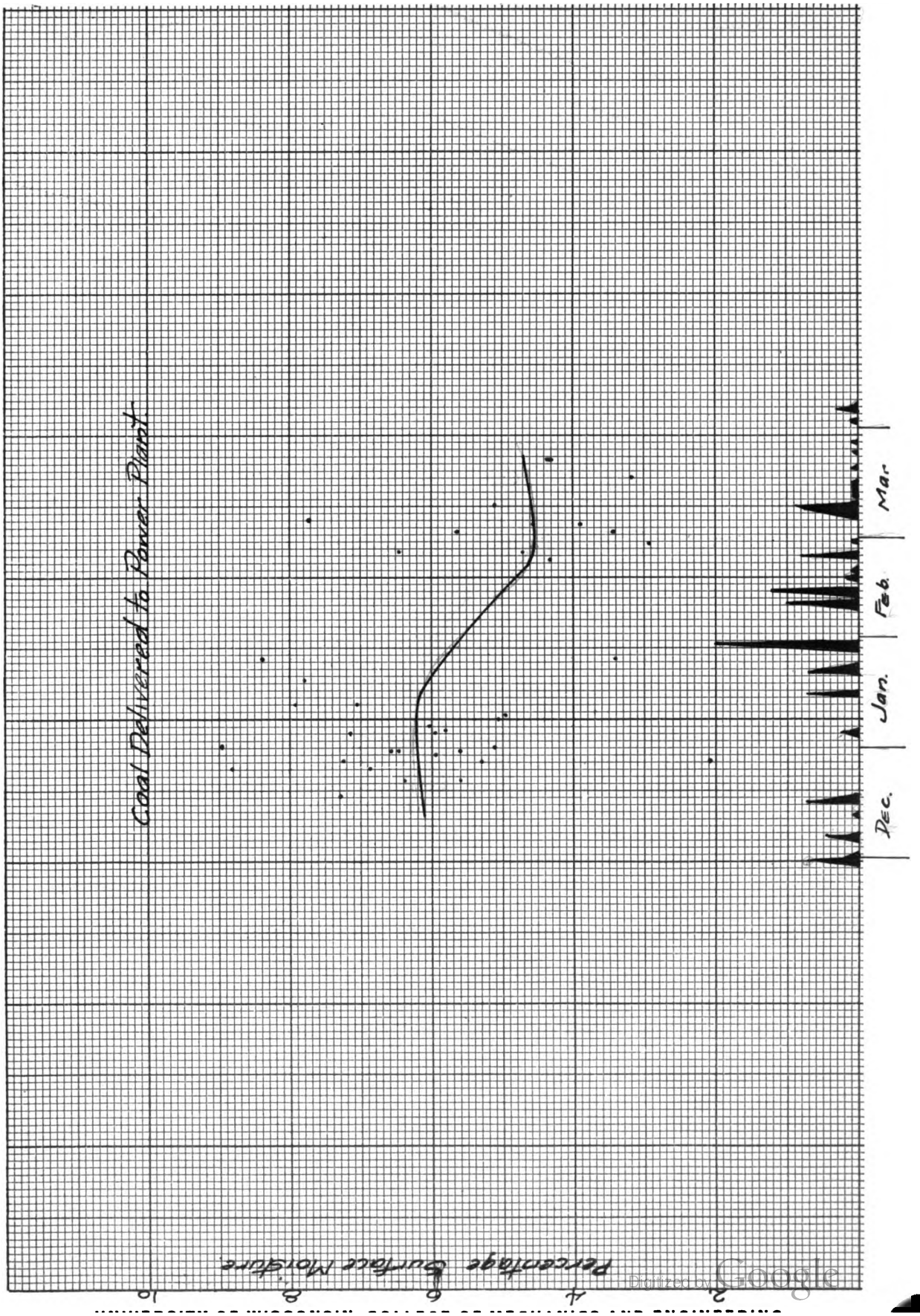
The data discussed above shows commercial conditions of shipping. One of the facts which we should take into account is that the coal upon which the data was obtained was washed coal and hence wet when shipped. A considerable percentage of the water left after washing as well as the rain which

may have fallen on the car during transit may have been absorbed by the wood of the car. After unloading, if the car was not weighed back at once this moisture would be given an opportunity to evaporate and the weight of the water charged in with the weight of the coal. Furthermore the effects of direct loss of coal which has been mentioned before must be borne in mind.

COAL PURCHASE UNDER CONTRACT. The coal which is delivered to the University of Wisconsin undoubtedly comes from the same mine and is mined and handled under the same conditions. The same is true of the other coals here represented. All of these coals are bought under contract with penalties for moisture above a certain percent, which probably accounts for the approximate uniform moisture conditions. Coal coming from the same mine and handled in approximately the same manner must undoubtedly have the same percentage of moisture, unless effected by external conditions as rainfall, temperature and so forth. There may be gradual changes ~~however~~ of the coal in the mine but any sudden variation must be accounted for by the conditions which the coal encounters in passing from the mine to the purchaser. When heavy penalties are inflicted for deterioration in the value of the fuel greater care will be exercised in handling from the time the coal is mined until it is delivered.

COAL PURCHASED WITHOUT CONTRACT AND SPECIFICATIONS. When coal is purchased without contract and specifications the coal dealer will probably furnish coal which he happens to have in his yard rather than from a particular mine. The result is the delivery of coal from many sources, and a consequent variation in the percentage of moisture as well as in the percentage of other constituents as combustible and ash. The difference which may occur is very well examplified by the coal delivered to the power plant whose coal is here represented in addition to that delivered to the University. A year ago this company did not purchase under contract. Tests which were then made showed a variation in moisture, as delivered, of from six to eighteen percent. Furthermore coal of different sizes and grades were furnished. This coal may have come from different sources of supply, it may consequently have been handled in various ways and met with different weather conditions, resulting in a wide range of moisture content.

IMPORTANCE OF CONTRACT. The importance of a contract is clearly evident if we consider nothing more than moisture conditions. A variation of ten percent in the moisture content of the coal would mean a corresponding variation of approximately ten percent in the value of the fuel. Variations in ash are equally important as they involve cost of handling besides decreasing the heat density of the fuel.



Furthermore the contract insures coal of uniform size which is very often of a direct advantage, and all coal delivered under a contract is very likely to come from one mine.

From the above it will be seen that the value of coal tests cannot be over estimated. The purchaser should at all times know the value of the fuel which is delivered to the station. If it is important to know the value of raw materials delivered to the plant it is certainly equally important to know the value of the fuel delivered to the power plant as the question of the cost of production is involved.

DISCUSSION OF SECOND CURVE. In the second series direct tests were run. The coal here represented was delivered to the power plant of a manufacturing company during the months of December of 1908 and January, February and March of 1909. The moisture content has been plotted graphically with rainfall as before. The direct tests of the samples were made as previously explained. This graphic chart shows the same general tendency as to the amount of moisture present in coal as is shown by the first graphic chart, namely a greater moisture content during the cold winter months of December and January. Both February and March were quite mild which may account for the reduced moisture content. In December and January six and one tenth percent is about the surface moisture which prevailed. For December we find six percent and for January six and two tenths percent. February and

March show an average of four and three fourths percent; February, four and fifty-five hundredths and March four and ninety five hundredths percent. No coal was delivered during the early part of February. Comparing this curve with the mine and delivered weight curve we find that it was in February that both curves show a marked decrease of moisture content, that it run about one percent above in the early months and changed to about three percent below the average in the later months. This agreement would lead us to conclude that the average surface moisture for the year and for these two kinds of Illinois coal is about five and three tenths to five and one half percent, that during the period in which delivered weights exceed mine weights the moisture increases to about six and one tenth to six and three tenths percent and during that period in which the mine weight exceeds the delivered weight it drops to about four and one half to four and seven tenths percent. The results of the tests recorded on page 29 show that the ash and heating value are quite uniform during the four months delivery, which further indicates the coal came from the same mine.

RESULTS. As previously pointed out the variations in moisture are not great when coal is delivered from the same mine. When coming from different mines and when coal receives different treatment, the variation in moisture may become considerable. It appears from the curves plotted

that temperature conditions have some effect upon the moisture content. Great differences which may be found in the value of fuels illustrate the importance of buying coal under contract and specifications and also the importance of tests by the purchaser in order to insure the delivery of coal in accordance with the specifications and contract. A loss of weight while in transit is not necessarily a loss of moisture but may be due to leakage of coal during shipment. This investigation shows that a loss of two percent as usually allowed by the mine owners meets the average condition.

DATA ON UNIVERSITY COAL.

Date	Ry. Wt.	Del. Wt.	$\frac{\text{Del. Wt.}}{\text{Ry. Wt.}}$ (%)
Sept. 19, 1908	90300	91400	101.2
" 24	65700	67200	102.3
" 28	91700	92700	101.0
" 30	67100	67600	100.8
Oct. 5	57500	57300	99.5
" 5	65400	63600	97.4
" 10	69600	69000	99.4
" 12	65000	64950	99.9
" 12	86800	86400	99.7
" 16	77400	77450	100.1
" 13	51300	51900	101.3
" 16	68600	66400	96.7
" 17	69200	67800	98.2
" 17	90000	89500	99.4
" 17	69800	72300	103.6
" 17	65100	65700	100.9
" 17	78600	78600	100.0
" 21	69500	68800	99.0
" 21	66000	64350	97.5
" 27	68300	66100	97.0
" 20	65100	65300	100.3
" 20	66400	60420	91.0
" 21	93000	91200	98.0

Oct.	21	68900	67050	97.0
"	21	69900	67700	97.0
"	22	64300	64650	100.2
"	22	66900	66500	99.5
"	22	93500	93800	100.4
"	24	95800	96920	103.3
"	25	60800	60960	100.2
"	27	66700	67640	101.8
"	27	66800	67300	100.7
"	27	95800	95560	99.7
"	28	70800	71300	100.7
"	28	67200	64160	95.5
"	31	77700	65800	84.6
"	31	72900	72500	99.5
"	31	66700	64000	96.0
Nov.	2	90500	88960	98.2
"	2	81800	81160	99.3
"	5	66600	62140	93.4
"	4	80000	80000	100.0
"	7	76200	42000	55.2
"	9	78600	78260	99.5
"	9	74400	75880	102.0
"	9	54600	65300	119.5
"	9	53300	82020	154.0
"	11	90600	89520	98.7
"	12	67500	67420	99.9

Nov.	13	48500	47440	97.6
"	13	91400	91080	99.7
"	16	53000	52040	98.3
"	16	94400	94640	100.1
"	16	94500	94940	100.5
"	17	67400	67300	99.8
"	17	94800	95500	100.7
"	17	83500	84180	100.7
"	18	95700	97280	101.8
"	19	68800	68640	99.7
"	19	67300	66880	99.4
"	19	91700	90800	99.0
"	19	78400	77560	99.1
"	19	68800	68640	99.8
"	21	66900	66000	98.7
"	21	67100	67780	100.8
"	21	96300	97720	101.6
"	21	74600	73360	97.3
"	21	68500	68320	99.8
"	21	91600	91600	100.0
"	21	40400	42540	105.3
"	21	93600	93860	100.2
"	22	92400	93170	100.8
"	22	56800	58000	102.1
"	22	91200	93660	102.7
"	23	78800	79900	101.4

Nov.	23	75600	77300	102.2
"	23	91200	91580	100.6
"	23	93200	94300	101.2
"	24	93700	93000	99.2
"	24	66300	66000	99.6
"	25	91900	93800	102.0
"	25	88600	90300	102.0
"	25	69500	68600	98.7
"	26	68400	66200	97.0
"	26	60900	59450	97.6
"	27	65400	61000	93.4
"	27	91600	90400	98.7
"	27	95700	95860	100.1
"	27	92700	93100	100.5
"	28	83100	83500	100.4
"	28	93200	93000	99.8
"	28	93800	93800	100.0
"	28	96700	96800	99.0
"	28	93500	94300	100.9
"	28	72000	72000	100.0
"	30	67700	68300	100.9
"	30	95600	96600	101.1
"	30	73500	72200	98.4
"	30	67900	69980	103.0
"	30	67700	68940	101.9
"	30	92500	92400	99.7

Nov.	30	86300	89080	104.2
"	30	68000	68200	100.3
"	30	68500	69760	101.9
"	30	66700	67300	101.0
"	30	75700	78400	103.6
"	30	76600	78100	102.0
Dec.	1	53800	54400	101.1
"	1	78600	79860	101.5
"	1	75800	75540	99.6
"	1	84800	85740	101.0
"	1	77400	72600	94.0
"	2	70000	69960	99.9
"	2	77400	78880	102.0
"	3	79500	80500	101.2
"	3	74000	75200	101.6
"	4	95700	95850	100.2
"	4	95900	96900	101.0
"	5	60100	56800	93.0
"	5	44100	46300	104.9
"	7	68500	69100	100.9
"	7	78400	78620	100.3
"	7	67500	67300	99.7
"	7	48500	49400	101.8
"	7	65800	67740	102.9
"	7	58700	59100	100.8
"	8	100700	99400	98.5

Dec.	8	92100	93500	101.8
"	8	68000	68300	100.3
"	8	64000	65150	102.0
"	8	89200	91600	102.8
"	8	95600	96700	101.0
"	9	49000	50500	103.0
"	9	66900	69400	103.8
"	9	66000	68380	103.5
"	10	67200	66800	99.4
"	10	50200	50700	101.1
"	10	60200	62800	104.3
"	11	59200	59800	101.1
"	11	75900	77100	101.8
"	11	71100	81000	114.0
"	12	92500	94700	102.4
"	12	71600	71900	100.4
"	13	51400	52700	102.6
"	14	90200	93900	104.1
"	14	64900	65700	101.2
"	14	68900	70000	101.8
"	15	66300	65600	99.1
"	15	64100	66900	104.2
"	15	50800	51100	100.8
"	15	67600	68400	101.1
"	15	66800	67600	101.2
"	15	70800	71900	101.6

Dec.	15	72700	72100	99.3
"	15	67900	69000	101.8
"	16	78200	80300	102.9
"	16	79600	80200	100.8
"	18	65800	66500	101.0
"	18	50000	48880	97.6
"	18	67600	68100	100.8
"	19	97300	96840	99.5
"	19	79400	78600	99.3
"	19	66700	66200	99.6
"	19	84300	84000	99.3
"	19	67500	68100	100.9
"	21	70000	69500	99.4
"	21	86000	86800	100.9
"	21	71100	70300	98.9
"	21	58800	58600	99.6
"	21	52200	53400	102.2
"	21	66600	67400	101.2
"	21	40000	37000	92.5
"	21	74500	74600	100.2
"	21	70700	69880	98.8
"	21	70100	68440	97.8
"	22	50800	45720	90.0
"	22	50700	50400	99.4
"	22	65800	65580	99.8
"	22	66200	65980	99.6

Dec.	22	49800	50300	101.0
"	22	81000	79500	99.3
"	22	68800	68200	99.2
"	22	65800	65600	99.8
"	22	65500	65200	99.6
"	22	48500	48560	100.1
"	22	70400	72700	103.2
"	22	73000	74740	102.3
"	23	70700	69600	98.5
"	23	49700	47200	95.2
"	24	72900	70100	96.1
"	24	93300	93300	100.0
"	24	48900	49000	100.2
"	24	67100	67320	100.2
"	24	92000	91900	99.9
"	26	50600	45440	89.7
"	26	67100	66700	99.4
"	26	67000	67280	100.4
"	28	92600	91000	98.4
"	28	88400	87500	99.1
"	29	95100	94550	99.4
"	29	75300	78800	104.8
"	29	68100	69000	101.2
"	29	47800	48700	101.8
"	29	51000	51000	100.0
"	29	49600	49000	98.0

Dec.	29	67900	68000	100.2
"	29	66000	66660	101.0
"	29	54100	53100	98.2
"	29	94000	94400	100.3
"	30	49200	50200	102.2
"	30	97400	98500	101.2
"	30	92000	93200	101.3
"	31	93500	94400	100.9
"	31	51700	50000	96.8
"	31	67800	70000	103.3
"	31	95300	95300	100.0
"	31	676004	67900	100.6
"	31	93500	92320	98.7
"	31	52100	52360	100.3
"	31	78300	78940	100.7
Jan.	2,1909	71000	71900	101.3
"	2	55700	56000	100.6
"	2	70300	70100	99.7
"	2	74100	74740	100.7
"	2	68600	66600	97.1
"	4	49500	49400	99.9
"	4	49700	49460	99.4
"	4	90900	90800	99.8
"	4	94600	97200	102.8
"	4	95300	96340	101.0

Jan.	5	70100	68900	98.4
"	7	67300	67600	100.6
"	7	93700	94000	100.3
"	7	69000	68100	98.7
"	8	68600	67200	98.0
"	12	94600	95500	100.9
"	12	51900	51900	100.0
"	12	93100	91900	98.8
"	12	65500	66400	101.4
"	12	96700	96000	99.3
"	13	63600	66000	103.8
"	13	90800	92700	102.2
"	14	96300	93700	97.4
"	14	92600	81800	88.3
"	14	95500	97300	101.8
"	15	51900	52600	101.4
"	16	90300	90160	99.9
"	16	93400	92560	98.2
"	16	86600	88600	102.3
"	18	93300	93300	100.0
"	18	51700	49580	96.0
"	19	95300	93000	97.6
"	21	66900	66800	99.9
"	21	84800	86400	101.9
"	21	68600	65800	96.0

Jan.	21	40100	40000	99.9
"	25	64600	65000	100.7
"	25	67900	68960	101.6
"	25	92100	92520	100.5
"	25	64100	62400	97.5
"	25	52900	55000	104.1
"	25	78600	79540	101.2
Feb.	3	93300	95500	102.5
"	4	94300	96360	102.2
"	9	92500	94420	102.0
"	10	97000	95400	98.4
"	12	66900	65200	97.5
"	14	95100	95800	100.7
"	14	67700	68840	101.7
"	14	52100	51480	98.6
"	17	66500	67100	101.0
"	17	53400	54500	102.1
"	18	92400	92100	99.8
"	18	96800	97240	100.6
"	19	96400	97800	101.5
"	19	92800	93600	100.9
"	22	88400	85300	96.6
"	24	87000	85400	97.1
"	26	97400	92400	95.0
"	26	93400	94600	101.3

Feb.	26	91800	89200	97.2
"	27	97700	97200	99.7
"	28	94300	99700	103.8
"	28	93900	95800	102.1
"	28	96100	97400	101.4
"	28	91600	93900	102.5
"	28	72600	71200	98.0
"	28	699000	68400	97.9
Mar.	2	93200	92600	99.4
"	3	93700	92300	98.6
"	4	70100	68500	97.8
"	4	96400	95400	99.0
"	5	93100	92800	99.6
"	5	95400	94500	99.1
"	8	94000	94600	100.6
"	8	51300	53000	103.4
"	8	93100	91800	98.6
"	9	94600	93400	98.6
"	8	86300	87400	101.3
"	10	93200	92700	99.5
"	10	68600	70600	103.0
"	10	68600	68700	100.2
"	12	69600	68800	98.9
"	12	94500	93800	99.3
"	12	92400	92500	100.1

Mar.	15	94300	94000	99.8
"	15	54300	53700	99.0
"	15	67900	65600	96.7
"	15	69600	68200	98.2
"	15	69600	68500	98.5
"	16	81200	84000	103.6
"	16	95000	92200	97.1
"	19	92400	92600	100.3
"	20	56700	53200	94.0
"	22	94300	94100	99.8
"	23	69500	67600	97.4
"	23	68600	69100	100.8
"	23	93400	93500	100.1
"	23	45900	45900	100.0
"	23	96300	96200	99.9
"	23	95400	96500	101.2
"	23	53800	52600	97.8
"	25	70600	69460	98.2
"	26	94500	93300	98.8
"	26	69600	69900	100.5
"	26	67600	67400	99.6
"	27	69100	67200	97.4
"	27	71400	70400	98.5
"	28	95100	92600	97.4
"	30	69400	69500	100.1

Mar.	30	69400	69500	100.1
"	30	69600	69200	99.4
"	30	55500	55800	100.4
"	30	67900	67200	99.0
"	30	69600	70000	100.6
"	30	93800	93500	99.8
"	30	67200	68700	102.0
Apr.	1	70500	69400	98.5
"	1	69200	63700	92.0
"	2	68200	65700	96.4
"	2	69800	68800	97.5
"	3	63600	60200	94.7
"	3	69300	68400	98.6
"	3	70300	68680	97.7
"	3	95800	94300	98.5
"	4	52800	52400	99.3
"	5	71200	68200	96.0
"	5	53900	53900	100.0
"	5	71400	69600	97.5
"	6	66900	66600	99.6
"	7	94200	93200	94.0
"	9	72900	69600	95.9
"	10	93900	92300	99.4
"	12	95400	93400	97.8
"	12	93000	92100	99.1

Apr.	12	98700	96500	97.8
"	16	96400	96000	98.6
"	17	94500	93900	99.4
"	20	71700	71000	99.2
"	20	94800	94200	99.3
"	21	93400	95400	102.1
"	22	70400	69900	99.4
"	23	96000	95200	99.2
"	23	95800	83700	97.9
"	27	67800	67900	100.2
"	27	94400	94100	99.8
"	30	94800	96800	102.1
May	1	95500	95100	99.7
"	5	94100	93900	99.8
"	5	94800	95300	100.6
"	5	93700	93100	99.4
"	6	95800	95000	99.2
"	14	66600	68100	102.3
"	18	86600	62960	72.5*
"	18	97900	94100	96.4
"	19	94300	96000	101.8
"	19	93800	93400	99.7

* Bottom dump open on arrival.

COAL DELIVERED TO POWER PLANT.

Date	% Surface Moisture	Date	% Surface Moisture
Dec. 17, 1908	7.30	Jan. 9	4.96
" 21	6.38	" 12	7.91
" 21	5.60	" 12	8.09
" 24	8.82	" 19	7.80
" 24	6.87	" 25	8.40
" 26	5.30	" 25	3.41
" 26	7.25	Mar. 2	3.43
" 26	2.10	" 2	5.63
" 29	5.97	" 4	4.55
" 30	6.48	" 4	3.90
" 30	5.60	" 5	7.72
" 30	6.57	" 9	5.10
" 31	5.11	" 17	3.17
" 31	8.97	" 22	4.31
Jan. 4, 1909	5.97	" 22	4.35
" 4	7.15	Feb. 22	4.33
" 5	5.80	" 24	4.70
" 6	6.01	" 24	6.46
" 8	5.07	" 26	2.97

ANALYSIS OF AIR DRIED SAMPLES.

Date	% moisture	% ash	% combustible	B.T.U. per lb.
Dec. 17, 1908	4.15	11.22	84.63	12280
" 21	1.33	5.09	93.58	13590
" 21	3.16	12.51	84.33	12230
" 24	1.13	7.38	91.49	13280
" 24	1.60	6.69	93.31	13530
" 26	1.89	7.71	90.40	13100
" 26	1.90	9.91	88.19	12790
" 26	2.10	10.99	86.20	12500
" 29	1.94	9.45	88.61	12580
" 30	1.57	8.49	88.94	13030
" 30	3.07	7.13	89.80	13010
" 30	2.74	99.60	87.30	12675
Feb. 22 to Mar. 22	3.00	9.25	87.75	

The above coal was delivered to the power plant.

WEATHER CONDITIONS.

Date	In. Rainfall	Date	In. Rainfall
Sept. 13, 1908	0.13	Jan. 21	0.34
" 28	0.57	" 22	0.23
" 29	0.07	" 28	0.40
" 30	0.01	" 29	0.96
Oct. 6	0.09	Feb. 9	0.49
" 23	0.11	" 10	0.04
" 24	0.26	" 12	0.06
" 25	0.13	" 13	0.60
" 26	0.05	" 17	0.08
Nov. 7	0.01	" 18	0.03
" 8	0.01	" 23	0.39
" 22	0.10	" 27	0.01
" 23	0.30	Mar. 6	0.03
" 24	0.77	" 8	0.36
" 25	0.54	" 9	0.43
" 29	0.34	" 10	0.05
" 30	0.07	" 12	0.01
Dec. 5	0.05	" 13	0.02
" 6	0.16	" 14	0.02
" 12	0.03	" 15	0.03
" 16	0.37	" 18	0.13
" 17	0.15	" 19	0.01
Jan. 4, 1909	0.12	" 23	0.01
" 15	0.28	" 26	0.02

WEATHER CONDITIONS.

Date	In. Rainfall	Date	In. Rainfall
Sept. 13, 1908	0.13	Jan. 21	0.34
" 28	0.57	" 22	0.23
" 29	0.07	" 28	0.40
" 30	0.01	" 29	0.96
Oct. 6	0.09	Feb. 9	0.49
" 23	0.11	" 10	0.04
" 24	0.26	" 12	0.06
" 25	0.13	" 13	0.60
" 26	0.05	" 17	0.08
Nov. 7	0.01	" 18	0.03
" 8	0.01	" 23	0.39
" 22	0.10	" 27	0.01
" 23	0.30	Mar. 6	0.03
" 24	0.77	" 8	0.36
" 25	0.54	" 9	0.43
" 29	0.34	" 10	0.05
" 30	0.07	" 12	0.01
Dec. 5	0.05	" 13	0.02
" 6	0.16	" 14	0.02
" 12	0.03	" 15	0.03
" 16	0.37	" 18	0.13
" 17	0.15	" 19	0.01
Jan. 4, 1909	0.12	" 23	0.01
" 15	0.28	" 26	0.02

Date	In. Rainfall
Apr. 2	0.04
" 5	0.15
" 6	0.04
" 12	0.48
" 14	0.10
" 15	0.12
" 16	0.07
" 17	0.70
" 18	2.01
" 21	0.73
" 25	0.01
" 26	0.28
" 27	0.03
" 28	1.42
" 30	0.09

Approved A. M. Richter

Professor of Experimental Engineering.